

INVESTMENT PROJECT EFFICIENCY EVALUATION

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Summary

Financial efficiency of investment project is being evaluated in this paper. It is showed that the net present value function is constant and that quota value is equal to c_0 when i converges to the infinite. Optimal rates i are analyzed in certain cases and everything is illustrated through examples.

Keywords: investment, efficiency, project, investor, money flow, interest rate.

1. Introduction

Given that project justification appraisal is carried out by measuring investments and the effects of these investments, and given that these effects can generally be different, we can observe them in different conditions and from different points of view.

In this paper we will concentrate on financial efficiency of investment project, which should answer the question how justified it is to invest financial assets into a certain project from the viewpoint of the company making the investment.

The project duration period is $T(n)$. In time $T(n)$ investments and expected investment effects are observed. For many business projects it is not possible to determine exact money flow, therefore statistical theory is used.

Assuming that c_t is money difference between money income and money outlay in any time interval during the project.

c_t = money income in moment t – money outlay in moment t .

If money flow is constant, then money flow net rate can be expressed as follows:

$$c(t) = c_1(t) - c_2(t),$$

where $c_1(t)$ is income rate, and $c_2(t)$ is outlay rate of money assets in the project moment t .

If the difference between income and outlay is larger than zero, then we talk about positive money flow, and if the difference is less than zero, then we talk about negative money flow.

For a particular investment project, let us assume that we know $T(n)$ (economic duration of a project) and net effects c_t .

It is not hard to conclude that the investment project value at its beginning is in a discrete case:

$$NVSV^{(0)}(i) = c_0 + \frac{c_1}{1+i} + \frac{c_2}{(1+i)^2} + \dots + \frac{c_{n-1}}{(1+i)^{n-1}} + \frac{c_n}{(1+i)^n},$$

i.e.:

$$NVSV^{(0)}(i) = \sum_{k=0}^n c_k (1+i)^{-k}$$

Equation 1

Where:

$NVSV^{(0)}(i)$ net present value at the beginning of a project
 i interest rate
 $T(n)$ project duration (usually years)
 c_k project net effect at the end of year k .

It is in investor's best interest to measure investment profitability with regard to other investments, as this will indicate whether it is advisable to enter the financial business. The issue here is whether we can enrich the given capital better than creditors.

Similarly to the previous situation, at the time T when the project finishes, we have the following situation:

$$\sum_t c_t (1+i)^{T-t} + \int_0^T c(t) (1+i)^{T-t} dt,$$

thus the net present value dependent on interest rate i equals to:

$$NVSV(i) = \sum_t c_t (1+i)^{T-t} + \int_0^T c(t) (1+i)^{T-t} dt$$

Equation 2

If we presume that $c(t) = 0$, then we get Equation (1).

By substituting $q = (1 + i)^{-1}$, we get $NVSV(i) = \sum_t c_t q^t$, i. e. (1).

Note 1.

If the project duration time is infinite, accumulation is not defined, whereas net present value is defined by Equation (2). It is not hard to see that the function

$NVSV(i)$ is a continuous function of interest rate and that $\lim_{i \rightarrow \infty} NVSV(i) = c_0$ ¹.

Assuming that the investment is with fixed interest rate i_l , equation (2) leads to the conclusion that the project is profitable if and only if $NVSV(i) > 0$.

If $NVSV(i)$ is moving from positive to negative values for i and around i_0 , then the project is profitable under these conditions if and only if $i_l < i_0$.

Note 2.

Financial efficiency evaluation of a project can be determined by mathematical analysis of a function graph $NVSV(i)$. When using net present value criteria, the problem is how to choose optimal interest rate i , in which money flows are discounted.

2. Examples

Example 1

If there is one investment c_0 at the beginning of the project duration, and if all effects are constant and greater than zero throughout the project, then net present value is:

$$NVSV^{(0)}(i_0) = c_0 + c \frac{r^n - 1}{r^n(r - 1)}_2,$$

where $r = 1 + i_0$, $i_0 = \frac{p_0}{100}$

The investment project is:

¹ M. Crnjac, Matematika za ekonomiste, Ekonomski fakultet, Osijek (2000)

² M. Crnjac, Matematika za ekonomiste, Ekonomski fakultet, Osijek (2000)

- 1) efficient if $NVSV^{(0)}(i_0) > 0$
- 2) neutral if $NVSV^{(0)}(i_0) = 0$
- 3) inefficient if $NVSV^{(0)}(i_0) < 0$

Example 2

Internal profitability rate i_r is the rate at which net present value of investment project is equal to zero. So, $NVSV^{(0)}(i_r) = 0$, i.e. $\sum_{k=0}^n c_k (1 + i_r)^{-k} = 0$. Given that i_0 is the profitability rate at which common enterprise projects are approved, it is not hard to conclude that the investment project is:

1. efficient for $i_r > i_0$
2. neutral for $i_r = i_0$
3. inefficient for $i_r < i_0$

Using iterative methods it is not hard to calculate internal profitability rate from the

equation $\sum_{k=0}^n c_k (1 + i_r)^{-k} = 0$.

Example 3

Asset return time $T(i_p)$ is the time necessary to return investments. It can be calculated by the equation $NVSV^{(0)}(t) = \sum_{k=0}^{T(i_p)} c_k (1 + i_p)^{-k} = 0$, where $NVSV^{(0)}(t)$ is the function of time. If t_0 is the return time for similar projects, the investment project is:

1. acceptable if $T(i_p) < t_0$,
2. neutral if $T(i_p) = t_0$,
3. unacceptable if $T(i_p) > t_0$,

Using the permanency principle we can calculate:

$$NVSV^{(0)}(0) = c_0$$

$$NVSV^{(0)}(1) = \sum_{k=0}^1 c_k (1+i_p)^{-k}$$

$$NVSV^{(0)}(2) = \sum_{k=0}^2 c_k (1+i_p)^{-k}$$

$$NVSV^{(0)}(3) = \sum_{k=0}^3 c_k (1+i_p)^{-k}$$

$$: NVSV^{(0)}(t) = \sum_{k=0}^t c_k (1+i_p)^{-k}$$

until we get $NVSV^{(0)}(t) < 0$ and $NVSV^{(0)}(t+1) \geq 0$ thus having return time $T(i_p)$ from the open interval $(t, t+1)$.

By using linear interpolation³ we have:

$$T(i_p) = t + \frac{NVSV^{(0)}(t)}{NVSV^{(0)}(t) - NVSV^{(0)}(t+1)}$$

References:

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³ R. Scitovski, R. Galić i M. Šilac-Benšić; Numerička matematika, vjerojatnost i statistika, Elektrotehnički fakultet, Osijek (1993)